

Discovery of Sound in the Sea 2013 Annual Report

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LONG-TERM GOALS

The long-term goal of this effort is to educate the public on the basic science of sound in the sea; how people and animals use underwater sound to accomplish many of the tasks for which we use light in air; and how sound in the ocean affects marine life. The products of this effort include an interactive on-line resource and printed materials.

OBJECTIVES

The objective of this effort is to develop and maintain resources that address the long-term goal. The resources include a website (Figure 1), a tri-fold educational pamphlet (available in multiple languages), and an informational, 16-page booklet (currently available in English and Spanish).

APPROACH

Efforts have focused on enhancing and expanding the scientific content of the *Discovery of Sound in the Sea* website that was launched in November 2002. During the past eleven years, Marine Acoustics, Inc. (MAI) and the University of Rhode Island's Graduate School of Oceanography (GSO) have developed a successful working relationship to create the website, an educational CD-ROM, and associated printed materials. These resources undergo regular updates and rigorous scientific review by a panel of scientists in the field, led by Drs. Peter Worcester (Scripps Institution of Oceanography), Jim Miller (University of Rhode Island), and Darlene Ketten (Harvard University Medical School and Woods Hole Oceanographic Institution). MAI and GSO make all final decisions on the site content.

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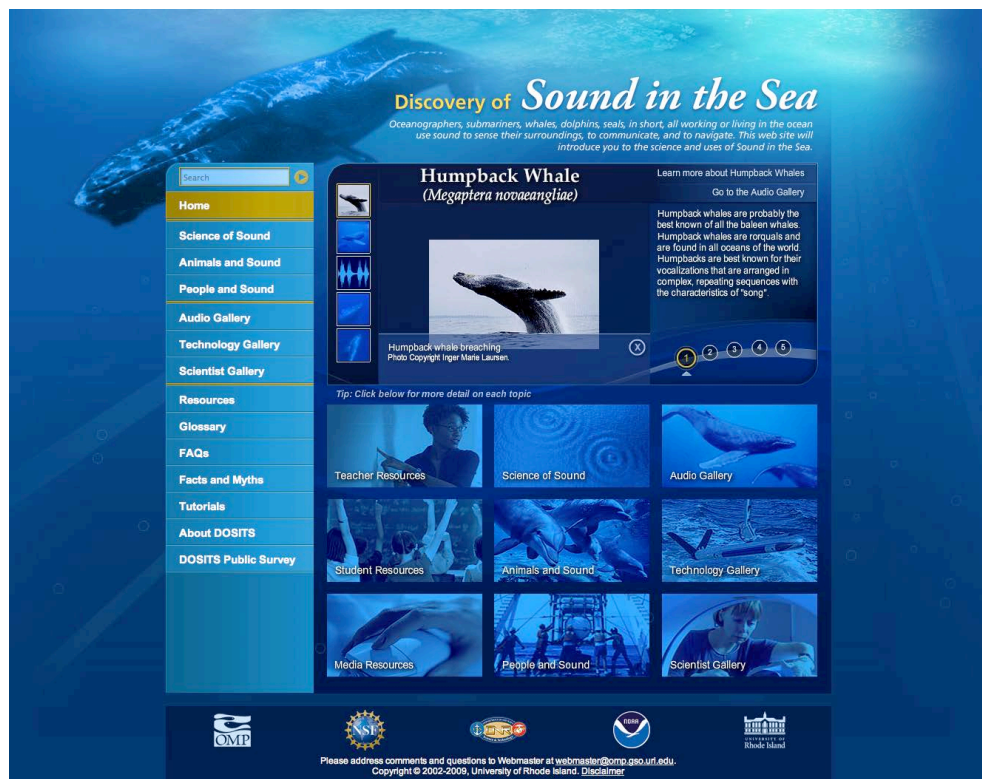


Figure 1: Interactive front page of “Discovery of Sound in the Sea” website (<http://www.dosits.org>)

WORK COMPLETED

During the eleventh year of research, MAI and GSO focused on several tasks to enhance and expand the website that was launched in November 2002, and to reach additional audiences that have not been targeted in the past. These tasks included the following:

1. Increases of readily available resources for educators. The DOSITS site is used in many classrooms around the country and teachers are continually expressing their appreciation of the resources available to them through our Teacher Resources section.
 - A. The *Build A Hydrophone* activity has been updated and expanded. Detailed graphics now accompany construction steps to better assist individuals with their build. The updated activity was presented during a half-day workshop at the 2013 National Science Teachers Association meeting in San Antonio, Texas. In addition, the DOSITS team is working with Dr. James H. Miller, a core member of the DOSITS advisory team who recently completed a rotational position at the NATO Undersea Research Center (NURC), to update the activity for European audiences and translate the activity to Italian.
 - B. A new DOSITS activity-based lesson focusing on statistical uncertainty is under development and will be added to the Teacher Resources section. The activity will be based upon advanced content available under the Science of Sound section (<http://www.dosits.org/science/advancedtopics/statisticaluncertainty/>).
 - C. A new entry on the speed of sound and potential effects of sound on marine life was reviewed at the Fall 2012 Advisory Meeting and uploaded to the DOSITS site.

- D. The DOSITS tutorials have been updated to reflect all new and expanded DOSITS content. The tutorials are designed to linearly build knowledge within the core topics discussed under Science of Sound, Animals and Sound, and People and Sound.

2. Updates to the *Science of Sound in the Sea* section.

- A. Developed new content on shock waves, as suggested by the DOSITS Advisory Panel. This new section addresses the issue of sound propagation from underwater explosive sources, from the initial, incoherent shock wave to the transition to a coherent sound wave. The new content includes various diagrams that illustrate the mechanics of sound production via underwater explosions, new glossary terms, and links to other, relevant DOSITS pages. A new Advanced Topic on underwater explosions, which discusses the complex physics of explosive sound sources, is also under development.
- B. Developed a new Advanced Topic, *Detection Threshold for Sonar*. As new and expanded content on intensity and acoustic soundscapes were added to the DOSITS site, the Advisory Panel proposed an additional, advanced section on detection thresholds. This new section discusses detection threshold in the context of signal processing and will provide new glossary terms as well as cross-links to advanced content on the sonar equation and an introduction to decibels.

3. Updates to the *Animals and Sound in the Sea* section.

- A. Revised and updated Animals > Produce Sound > Marine Invertebrates
- B. Revised and updated Animals > Use of Sound > Marine Mammals > Communication
- C. Revised and updated Animals > Use of Sound > Marine Invertebrates > Communication
- D. Revised and updated Animals > Use of Sound > Marine Mammals > Feeding
- E. Revised and updated Animals > Use of Sound > Marine Invertebrates > Feeding
- F. Revised and updated Animals > Use of Sound > Marine Mammals > Navigation
- G. Developed a new Advanced Topic, *Sound Source Localization*. One of the most important roles of hearing is to enable an animal to determine the direction of a sound source relative to its own position. This new Advanced Topic will discuss the physiology and functionality behind sound source localization in marine animals.
- H. Reviewed recently published, peer-reviewed literature to update existing scientific content, particularly the effects of underwater sound on marine life.

4. Updates to the *People and Sound in the Sea* section.

- A. Revised and updated People > National Defense > *How is sound used to find submarines?*
- B. Revised and updated People > National Defense > *How is sound used to monitor nuclear testing?*
- C. Developed a new Advanced Topic, *Locating a Sound Source by Hyperbolic Fixing*. This new advanced section discusses the science of sound localization (how it is done, different methods, etc.) and builds off topics discussed in the DOSITS Technology Gallery on archival marine acoustic recording units and real-time passive acoustic sensors.
- D. Updated and expanded the *History of Underwater Acoustics* section to include a more detailed discussion on the decommissioning of the Pt. Sur and San Nicolas Island Sound

SRveillance System (SOSUS) stations
(<http://www.dosits.org/people/history/SOSUShistory/>).

5. Expansion of the Audio and Technology Galleries. Contacts are continually made with researchers studying and using underwater sound, to provide material for revising and expanding the existing content in the Audio Gallery and Technology Gallery. Since these sections attract a high volume of web traffic, they need to be revised and updated on a timely basis.
 - A. As originally proposed, new sounds added to the DOSITS Audio Gallery include underwater recordings of ribbon seal vocalizations, wind turbine operations, and a variety of pile driving operations. Underwater recordings of personal watercraft (e.g. jet skis), Dall's porpoise vocalizations, and sea urchin feeding sounds were also added to the Audio Gallery. Current Audio Gallery pages for bowhead whales, narwhals, and harbor seals were expanded to include new sounds and/or images. Longer audio files continue to be added when possible.
 - B. Updated information on recent advancements with underwater cabled observatories was added to Technology Gallery content on Real Time Passive Acoustic Sensors. Several, real-time observation platforms providing continuous data on ocean temperature, salinity, currents, and acoustics, have been launched, and DOSITS now includes links to these data streams.
 - C. New content on explosive sound sources is being developed for the Audio and Technology Galleries. These pages will link to new content on shock waves under Science of Sound.
6. Creation of a DOSITS Career Gallery. There is a need to draw students into science careers. This is especially critical as 65% of all naval scientists are 40 years or older and will need to be replaced by well-educated US citizens. The DOSITS Team, with guidance from the Advisory Panel, has developed a searchable career gallery that describes 20+ ocean careers. Each career description includes details such as estimated salary, educational requirements, knowledge and skills, and duties and responsibilities, and provides a connection to acoustics. Links to the DOSITS Technology Gallery and other content pages are also listed for each career description. The format of the gallery follows that of the Audio and Scientist Galleries, and thus, should be familiar and easy to use for DOSITS visitors.
7. Enhancements to the DOSITS website. Raytheon Web Solutions (RWS) made improvements to the DOSITS website that included changes designed to decrease page load times; code changes and updates to take advantage of modern HTML and CSS standards, allow for new approaches to visitor logging, and to make the site more mobile friendly; fixes to a few bugs in the code; and improvements to the backend content management system.
8. Continued addition of cross-links between existing content. While an attempt was made to integrate new material with existing content, additional cross-references were needed among content pieces to provide a broader understanding of underwater sound. In addition, with eleven years of detailed web traffic data, cross-links from web pages that receive high amounts of web traffic, such as the Audio Gallery, can draw the user into pages that have traditionally received less traffic.
9. Translated and printed DOSITS public affairs publications. The DOSITS educational booklet provides an in-depth look at Sound in the Sea and targeted issues for interested stakeholders, policymakers, and the public. In 2011-2013 the DOSITS Team planned to translate the entire DOSITS website into Spanish. This originally appeared to be a feasible task that could be

completed in stages. However, the initial investment of establishing a mirror site of DOSITS in Spanish would require substantial work by RWS, for which there was no funding. Therefore, it was decided that it was more cost effective to translate the 16-page educational booklet into Spanish. Spanish booklets have been well-received at several national and international conferences and have been sent to colleagues serving multilingual communities. The booklet has also been distributed in Mexico to artisanal fishermen who take hundreds of tourists on whale watches during the winter months.

The DOSITS tri-fold brochure was translated to French for distribution at the 21st International Congress of Acoustics in Montreal in June 2013. Translations to Spanish, and German are also underway. All translated materials will be available for download from the Teacher Resources section of the DOSITS website.

10. Further promotion of the DOSITS project. The DOSITS project was again promoted at the 2013 National Science Teachers Association Meeting, which took place in San Antonio, Texas. A half-day workshop was conducted on how to build a hydrophone (for classroom use). The DOSITS project was also promoted at an international level with activities at the 21st International Congress of Acoustics in Montreal, Canada, 2013 Effects of Noise on Aquatic Life Conference in Budapest, Hungary, and the European Marine Educators Association Meeting in Plymouth, UK. During the 21st International Congress of Acoustics, the DOSITS Team organized an evening symposium series to highlight recent advancements in acoustics. The DOSITS Team also collaborated with the Acoustical Society of America's Education Team to again deliver an overview of underwater acoustics to a group of Girl Guides, the Canadian equivalent of the Girls Scouts of America. During the 2013 Effects of Noise on Aquatic Life Conference, the DOSITS Team led an evening workshop for graduate students and postdocs on effective communication of science and demonstrated the DOSITS website as an example of a successful outreach project.
11. Conducted peer review of the website. Review meetings with the advisory team were held at URI during November 2012 and April 2013 to review the draft revised version of the website. An October 2013 Advisory Review Meeting is also being planned. All new and revised content created for the website underwent peer review during this time period. In addition to the advisory team, the DOSITS scientific content has been reviewed by over 40 scientific experts (see <http://www.dosits.org/about/> for a complete list).

RESULTS

The "Discovery of Sound in the Sea" website has received an overwhelming response. It was first launched in November 2002. Through August 2013 DOSITS has had more than 67 million hits (Figure 2). From September 1, 2012 to August 31, 2013, the DOSITS site had 12.7 million hits and more than 810,000 page views. In calendar years, 2013 traffic to DOSITS is on pace to exceed the 2012 traffic levels by approximately 25%. About 21% of the traffic to DOSITS is from a mobile device (phone, tablet, etc.) and about 70% of that traffic is from iOS devices. Most of the traffic to DOSITS is still from North America (almost all US) but traffic from Europe, Asia, and the Australia Region are all growing.

IMPACT/APPLICATIONS

The "Discovery of Sound in the Sea" website and printed publications are resources for educating and exposing the public to the basic science of sound in the sea and how it is used to communicate, navigate, and explore the oceans. By providing information in multiple formats, teachers can bring this

content into their classrooms; public affairs personnel can inform themselves of controversial issues and provide materials to Congress; and the public can begin to include science in their decisions. DOSITS is recognized as a resource by established journal outlets, as evidenced by our involvement in the January 2011 issue of National Geographic “The Big Idea” section (<http://ngm.nationalgeographic.com/2011/01/big-idea/noisy-ocean>).

TRANSITIONS

DOSITS is recognized as the world leader in education and outreach on underwater acoustics. With the appropriate permissions, the National Oceanic and Atmospheric Administration has incorporated components of the DOSITS Audio Gallery into its exhibit “Sounds of the Sea” for the Smithsonian Institution’s National Museum of Natural History Ocean Hall “Oceans Today” kiosks. These kiosks are located at the entrance to the Ocean Hall, thereby making it one of the first components that visitors to this newly constructed exhibit will encounter. This prominent placement ensures a very broad impact from the work of the DOSITS team.

RELATED PROJECTS

None.

PUBLICATIONS

“Discovery of Sound in the Sea” website

“Discovery of Sound in the Sea” CD-ROM

Scowcroft, G., Vigness Raposa, K., Knowlton, C., and Morin, H. 2011. Discovery of Sound in the Sea. University of Rhode Island. (16-page information booklet)

Scowcroft, G., Vigness Raposa, K., Knowlton, C., and Morin, H. 2010. Discovery of Sound in the Sea. University of Rhode Island. (tri-fold pamphlet)

Vigness-Raposa, K.J., Scowcroft, G., Miller, J.H., and Ketten, D.R. 2012. Discovery of Sound in the Sea: An on-line resource. *In: The Effects of Noise on Aquatic Life* (Arthur N. Popper and Anthony Hawkins, eds.). Springer, New York.

Vigness-Raposa, K.J., Scowcroft, G., Knowlton, C., and Worcester, P.F. 2008. Discovery of Sound in the Sea Website: An educational resource. *Bioacoustics* 17: 348-350.

HONORS/AWARDS/PRIZES

2007 Acoustical Society of America Science Writing Award for Media other than an Article

DOSITS Monthly Hits 2003 through Aug 2013

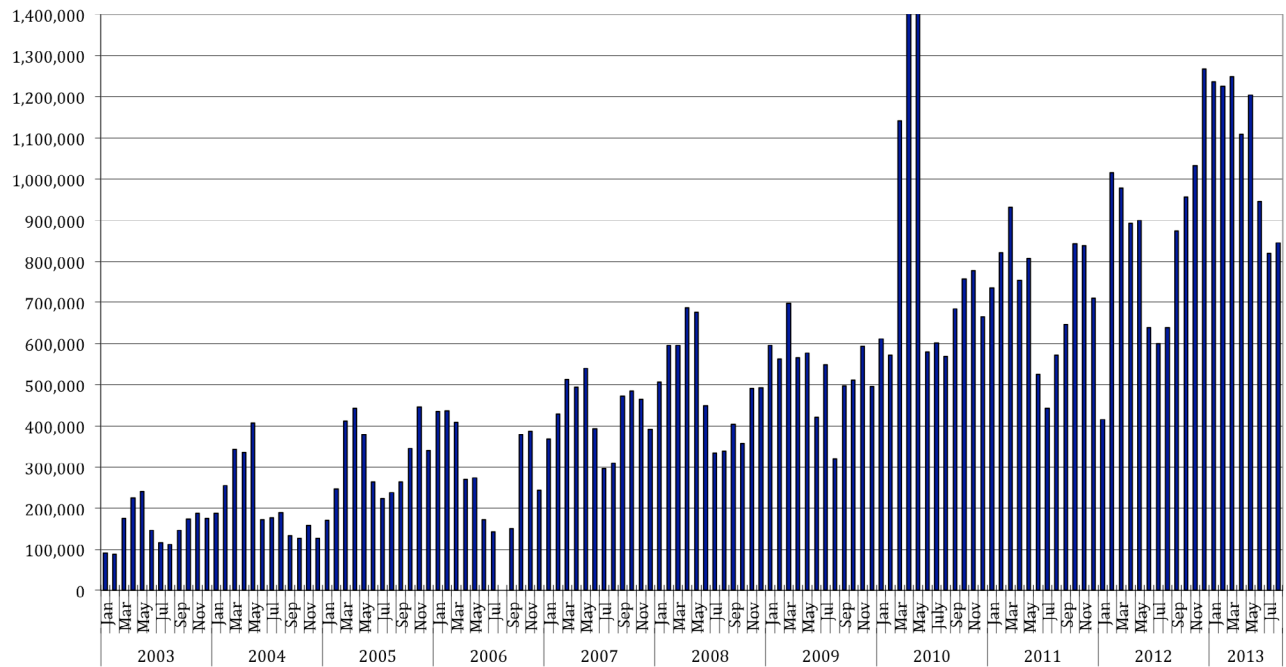


Figure 2: The “Discovery of Sound in the Sea” website (<http://www.dosits.org>) has received over 67 million hits since it was first launched in November 2002.